

Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Cancelled)
2. (Previously Presented) An exposure apparatus for exposing with X-rays a pattern present on a mask onto a photosensitive substrate, comprising:
 - a. an optical system having a plurality of reflective surfaces arranged in an optical path to receive the X-rays so as to guide the X-rays to the mask and to transfer the mask pattern onto the photosensitive substrate;
 - b. a detection apparatus electrically connected to at least one of the reflective surfaces and designed to detect photoelectrically generated electrons from the at least one of the reflective surfaces when the at least one of the reflective surfaces is irradiated with the X-rays, and to provide a first output signal corresponding to an amount of the photoelectrically generated electrons detected;
 - c. an exposure dose calculation apparatus, electrically connected to the detection apparatus, for calculating based on the first output signal, an exposure dose of the X-rays at the mask and capable of generating a second output signal corresponding to the exposure dose; and
 - d. an X-ray limiting apparatus electrically connected to the exposure dose calculation apparatus, for controlling the illumination of the X-rays based on the second output signal.
3. (Previously Presented) An exposure apparatus for exposing with X-rays a pattern present on a mask onto a photosensitive substrate, comprising:

a. an optical system having a plurality of reflective surfaces arranged in an optical path to receive the X-rays so as to guide the X-rays to the mask and to transfer the mask pattern onto the photosensitive substrate;

b. a detection apparatus electrically connected to at least one of the reflective surfaces and designed to detect photoelectrically generated electrons from the at least one of the reflective surfaces when the at least one of the reflective surfaces is irradiated with the X-rays, and to provide a first output signal corresponding to an amount of the photoelectrically generated electrons detected;

c. an exposure dose calculation apparatus, electrically connected to the detection apparatus, for calculating based on the first output signal, an exposure dose of the X-rays at the photosensitive substrate and capable of generating a second output signal corresponding to the exposure dose; and

d. an X-ray limiting apparatus electrically connected to the exposure dose calculation apparatus, for controlling the illumination of the X-rays based on the second output signal.

4. - 13. (Cancelled)

14. (Previously Presented) An exposure apparatus comprising:

a. an X-ray radiation source that generates X-rays;

b. an optical system disposed in an optical path to receive the X-rays and that guides the X-rays to a mask having a pattern, and then to a photosensitive substrate so as to form on the photosensitive substrate the pattern of the mask, the optical system including a plurality of optical elements, at least one of the optical elements exhibits a photoelectric effect upon irradiation by the X-rays;

c. a detection apparatus arranged relative to the at least one of the optical elements so as to detect photoelectrically generated electrons from the at least one of the

optical elements, and which provides a first output signal corresponding to an amount of the photoelectrically generated electrons detected;

d. an exposure dose calculation apparatus electrically connected to the detection apparatus, that calculates an exposure dose of X-rays at the mask based on the first output signal, and generates a second output signal corresponding to the calculated exposure dose; and

e. an X-ray limiting apparatus that limits the guidance of X-rays to the mask based on the second output signal.

15. (Previously Presented) An exposure apparatus comprising:

a. an X-ray radiation source that generates X-rays;

b. an optical system disposed in an optical path to receive the X-rays and that guides the X-rays to a mask having a pattern, and then to a photosensitive substrate so as to form on the photosensitive substrate the pattern of the mask, the optical system including a plurality of optical elements, at least one of the optical elements exhibits a photoelectric effect upon irradiation by the X-rays;

c. a detection apparatus arranged relative to the at least one of the optical elements so as to detect photoelectrically generated electrons from the at least one of the optical elements, and which provides a first output signal corresponding to an amount of the photoelectrically generated electrons detected;

d. an exposure dose calculation apparatus, electrically connected to the detection apparatus, for calculating, based on the output signal, an exposure dose of the X-rays at the photosensitive substrate and for generating a second output signal corresponding thereto; and

e. an X-ray limiting apparatus electrically connected to the exposure dose calculation apparatus, for controlling the illumination of the X-rays based on the second output signal.

16. - 20. (Cancelled)

21. (Original) A method for controlling radiation exposure dose in a photolithographic process comprising the steps of:

- a. monitoring photoelectrically generated electrons from at least one reflective surface of a plurality of reflective surfaces in relative alignment used during a photolithographic exposure process;
- b. determining from said monitoring if the exposure dose meets one or more predefined parameters; and
- c. stopping the radiation exposure when the exposure dose meets said one or more predefined parameters.

22. (Original) An exposure dose control method of claim 21, further comprising the steps of:

- a. determining from said monitoring if loss of alignment in said plurality of reflective surfaces is occurring; and
- b. adjusting a position of at least one of said reflective surfaces to realign said plurality of reflective surfaces.

23. (Original) The exposure control method of claim 21, wherein said monitoring is conducted during an X-ray radiation exposure process.

24. (Original) A method for controlling radiation exposure dose in a photolithographic process comprising the steps of:

- a. monitoring photoelectrically generated electrons from at least one optical element of a plurality of optical elements used during a photolithographic exposure process;
- b. determining from said monitoring if the exposure dose meets one or more predefined parameters; and
- c. stopping the radiation exposure when the exposure dose meets said one or more predefined parameters.

25. (Original) The exposure control method of claim 24, wherein said monitoring is conducted during an X-ray radiation exposure process.

26. - 33. (Cancelled)

34. (Previously Presented) A method for manufacturing a semiconductor device, comprising:

guiding X-rays to a mask with a pattern by using an optical system, the optical system including a plurality of reflective surfaces that form an illumination field onto the mask;

detecting photoelectrically generated electrons from at least one of the reflective surfaces when the at least one of the reflective surfaces is irradiated with the X-rays;

transferring the mask pattern onto a photosensitive substrate;

obtaining a change of a characteristic that is necessary to perform the transferring step, based on a detecting information from the detecting step;

calculating an exposure dose based on obtaining information from the obtaining step; and

controlling the exposure dose based on a calculating information from the calculating step.

35. - 50. (Cancelled)

51. (Currently Amended) An illumination apparatus, comprising:

an illumination system which includes at least two optical members so as to guide light-radiation having a predetermined wavelength to an object to be irradiated;

a signal generator that is electrically connected to the at least two optical members and that generates electrical information based on a photoelectric effect which is caused by the light-radiation being irradiated to the at least two optical members; and

a detector that is electrically connected to the signal generator and that detects an optical characteristic or a deterioration of an optical characteristic with respect to at least one of the at least two optical members based on the electrical information generated by the signal generator, wherein the detector detects an optical characteristic or a deterioration of an optical characteristic with respect to one of the optical members based on the electrical information generated by the signal generator for more than one of the optical members so that influences of the more than one optical members on the photoelectric effect caused at the one optical member can be taken into account in detecting the optical characteristic or the deterioration of the optical characteristic of the one optical member.

52. (Previously Presented) An illumination apparatus according to claim 51, wherein at least one of the at least two optical members includes a reflective member.

53. (Previously Presented) An illumination apparatus according to claim 51, wherein the signal generator includes one of a grounded ammeter and a voltmeter.

54. (Previously Presented) An illumination apparatus according to claim 51, wherein the signal generator includes electrode members having a positive electric potential respectively arranged in correspondence to each of the at least two optical members, and the electrode members are arranged in a vicinity of a corresponding one of the optical members.

55. (Currently Amended) An illumination apparatus according to claim 51, further comprising:

a light-radiation source which supplies 5 nm-20 nm light-radiation as the light radiation having the predetermined wavelength.

56. (Currently Amended) An exposure apparatus which exposes a pattern of a mask onto a photosensitive substrate, comprising:

an illumination system which includes at least two optical members so as to guide light-radiation having a predetermined wavelength to the mask;

a signal generator that is electrically connected to the at least two optical members and that generates electrical information based on a photoelectric effect which is caused by the light-radiation being irradiated to the at least two optical members; and

a detector that is electrically connected to the signal generator and that detects an optical characteristic and a deterioration of an optical characteristic with respect to at least one of the at least two optical members based on the electrical information generated by the signal generator, wherein the detector detects an optical characteristic and a deterioration of an optical characteristic with respect to one of the optical members based on the electrical information generated by the signal generator for more than one of the optical members so that influences of the more than one optical members on the photoelectric effect caused at the one optical member can be taken into account in detecting the optical characteristic and the deterioration of the optical characteristic of the one optical member.

57. (Previously Presented) An exposure apparatus according to claim 56, wherein at least one of the at least two optical members includes a reflective member.

58. (Previously Presented) An exposure apparatus according to claim 56, wherein the signal generator includes one of a grounded ammeter and a voltmeter.

59. (Previously Presented) An exposure apparatus according to claim 56, wherein the signal generator includes electrode members having a positive electric potential

respectively arranged in correspondence to each of the at least two optical members, and the electrode members are arranged in a vicinity of a corresponding one of the optical members.

60. (Previously Presented) An exposure apparatus according to claim 56, further comprising:

a projection system which includes a plurality of reflective members in order to project an image of the pattern of the mask onto the photosensitive substrate.

61. (Currently Amended) An illumination apparatus according to claim 56, further comprising:

a light-radiation source which supplies 5 nm - 20 nm light-radiation as the light-radiation having the predetermined wavelength.

62. (Previously Presented) An exposure method using the exposure apparatus as set forth in claim 60, comprising:

illuminating the mask by using the illumination system; and

projecting the pattern of the mask onto the photosensitive substrate by using the projection system.

63. (Currently Amended) An exposure apparatus, comprising:

an exposure optical system which includes a projection system which projects an image of a pattern of a mask onto a photosensitive substrate in order to expose the pattern of the mask onto the photosensitive substrate by illuminating the mask with light-radiation having a predetermined wavelength;

a signal generator that is electrically connected to at least one reflective member among a plurality of reflective members that are provided in the exposure optical system and that generates electrical information based on a photoelectric effect which is caused by the light-radiation being irradiated onto the at least one reflective member;

a calculation device that is electrically connected to the signal generator and that calculates an amount of correction of an optical characteristic of the projection system based on the electrical information generated by the signal generator; and

an adjusting device that is electrically connected to the calculation device and that adjusts the optical characteristic of the projection system based on the calculated amount of correction.

64. (Previously Presented) An exposure apparatus according to claim 63, wherein the calculation device includes a first calculation unit that calculates an amount of deformation of at least one reflective member of the projection system, and a second calculation unit that calculates an amount of adjustment according to the calculation result of the first calculation unit.

65. (Previously Presented) An exposure apparatus according to claim 63, wherein: the projection system includes a plurality of the reflective members; and the adjusting device adjusts at least one of the plurality of reflective members of the projection system.

66. (Previously Presented) An exposure apparatus according to claim 63, wherein the signal generator generates the electrical information from at least one reflective member of the plurality of reflective members of the projection system.

67. (Previously Presented) An exposure apparatus according to claim 63, wherein the signal generator includes one of a grounded ammeter and a voltmeter.

68. (Previously Presented) An exposure apparatus according to claim 63, wherein the signal generator includes an electrode member having a positive electric potential that is arranged in a vicinity of the at least one reflective member among the plurality of reflective members.

69. (Currently Amended) An exposure apparatus according to claim 63, further comprising:

a light-radiation source which supplies 5 nm-20 nm light-radiation as the light-radiation having the predetermined wavelength.

70. (Currently Amended) An exposure method using the exposure apparatus as set forth in claim 63, comprising:

illuminating the light-radiation having the predetermined wavelength onto the mask; and

projecting the image of the pattern of the mask onto the photosensitive substrate by using the projection system.

71. (Currently Amended) An exposure apparatus, comprising:

an illumination system that illuminates light-radiation having a predetermined wavelength onto a mask;

a projection system that includes a plurality of reflective members so as to project an image of a pattern of the mask onto a photosensitive substrate;

a signal generator that is electrically connected to at least one reflective member among the plurality of reflective members and that generates electrical information based on a photoelectric effect which is caused by the light-radiation being irradiated to the at least one reflective member;

a calculation device that is electrically connected to the signal generator and that calculates an amount of correction of an optical characteristic of the projection system based on the electrical information generated by the signal generator; and

an adjusting device that is electrically connected to the calculation device and that adjusts the optical characteristic of the projection system based on the calculated amount of correction.

72. (Previously Presented) An exposure apparatus according to claim 71, wherein the calculation device includes a first calculation unit that calculates an amount of deformation of at least one reflective member of the projection system, and a second calculation unit that calculates an amount of adjustment from the calculation result of the first calculation unit.

73. (Previously Presented) An exposure apparatus according to claim 71, wherein the adjusting device adjusts at least one of the plurality of reflective members of the projection system.

74. (Previously Presented) An exposure apparatus according to claim 71, wherein the signal generator includes one of a grounded ammeter and a voltmeter.

75. (Currently Amended) An exposure apparatus according to claim 71, further comprising:

a light-radiation source which supplies 5 nm-20 nm light-radiation as the light radiation having the predetermined wavelength.

76. (Previously Presented) An exposure method using the exposure apparatus as set forth in claim 71, comprising:

illuminating the mask by using the illumination system; and

projecting the pattern of the mask onto the photosensitive substrate by using

the projection system.

77. (Currently Amended) An exposure apparatus, comprising:

a light-radiation source that supplies light-radiation having a predetermined wavelength;

an exposure optical system which includes a plurality of optical members so as to expose a pattern of the mask onto a photosensitive substrate by illuminating the light radiation having the predetermined wavelength onto the mask;

a signal generator that is electrically connected to at least one optical member among the plurality of optical members and that generates electrical information based on a photoelectric effect which is caused by the light-radiation being irradiated to the at least one optical member; and

a controller that is electrically connected to the signal generator and that performs a predetermined control based on the electrical information generated by the signal generator.

78. (Currently Amended) An exposure apparatus according to claim 77, wherein the controller controls at least one of a characteristic of light-radiation from the light-radiation source, an exposure characteristic in an exposure region formed on the photosensitive substrate, and an optical characteristic in the exposure region formed on the photosensitive substrate.

79. (Currently Amended) An exposure apparatus according to claim 77, wherein the controller includes a calculation device that is electrically connected to the signal generator and that calculates an amount of exposure based on the light-radiation having the predetermined wavelength, and an adjusting device that is electrically connected to the calculation device and that adjusts an output of the light-radiation source based on the output from the calculation device.

80. (Previously Presented) An exposure apparatus according to claim 77, wherein the controller includes:

a calculation device that is electrically connected to the signal generator and that calculates an amount of correction of an optical characteristic of the exposure optical system based on the electrical information generated by the signal generator; and

an adjusting device that is electrically connected to the calculation device and that adjusts the optical characteristic of the exposure optical system based on the calculated amount of correction.

81. (Previously Presented) An exposure apparatus according to claim 80, wherein the calculation device includes a first calculation unit that calculates an amount of deformation of at least one reflective member of the exposure optical system, and a second calculation unit that calculates an amount of change according to the calculation result of the first calculation unit.

82. (Currently Amended) An exposure apparatus according to claim 77, wherein the light-radiation source supplies 5 nm - 20 nm light-radiation as the light-radiation having the predetermined wavelength.

83. (Previously Presented) An exposure method using the exposure apparatus as set forth in claim 77, comprising:

illuminating the mask by using an illumination system of the exposure optical system; and

projecting a pattern of the mask onto the photosensitive substrate by using a projection system of the exposure optical system.